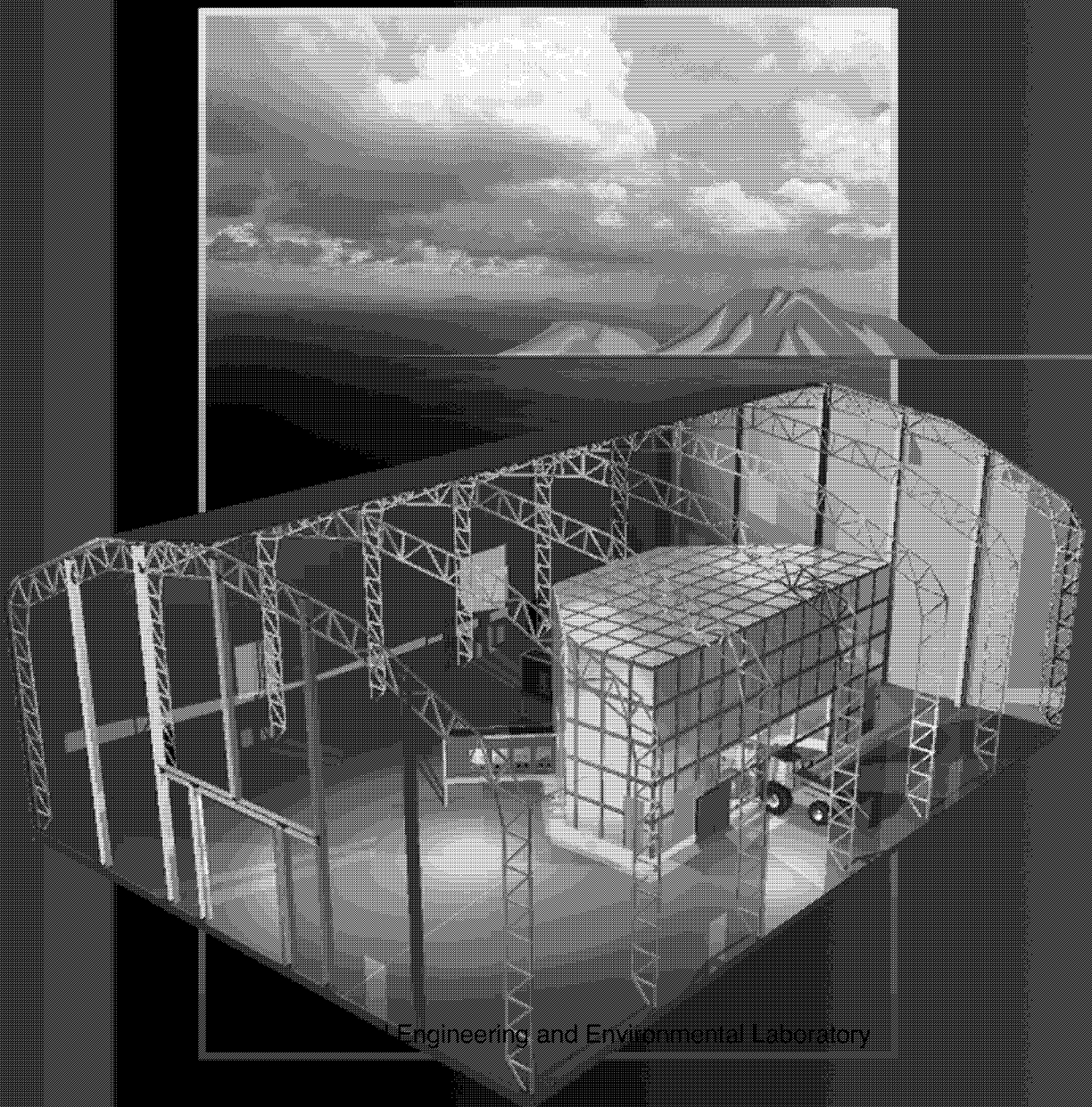
INEEL/EXT-01-01512

OU 7-10 Glovebox Excavator Method Project

Conceptual Design Report
for Critical Decision 1

January 2002



Engineering and Environmental Laboratory

INEEL/EXT-01-01512

OU 7-10 Glovebox Excavator Method Project

Conceptual Design Report for Critical Decision 1

January 2002

Idaho National Engineering and Environmental Laboratory
Idaho Falls, Idaho 83415

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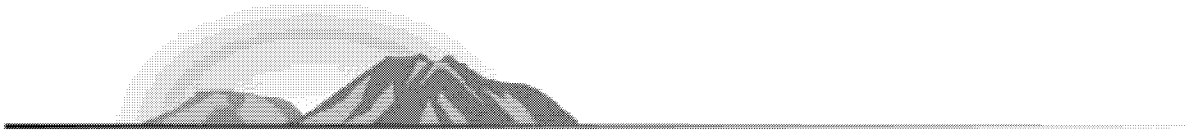
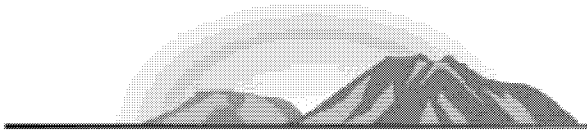


ABSTRACT

This report describes the conceptual design of the Operable Unit 7-10 Glovebox Excavator Method Project approved by the U.S. Department of Energy to retrieve, characterize, and store transuranic waste on an interim basis at the Idaho National Engineering and Environmental Laboratory. The project uses a commercial excavator, operated from outside a confinement structure, to remove waste inside the structure. The waste is placed in carts and transported to gloveboxes, connected to the confinement structure, where personnel can safely inspect, characterize, and package excavated material. This method will cut more than 5 years from the original Stage II remediation schedule and 37% from the original Stage II cost, while at the same time ensuring safety for workers and the environment.



EXECUTIVE SUMMARY

This report describes the conceptual design of the Operable Unit (OU) 7-10 Glovebox Excavator Method Project chosen by the U.S. Department of Energy (DOE) to demonstrate retrieval of transuranic waste from OU 7-10 at the Idaho National Engineering and Environmental Laboratory (INEEL). The report establishes the project's technical baseline and serves as a primary input for the *OU 7-10 Glovebox Excavator Method Project Critical Decision 1.*

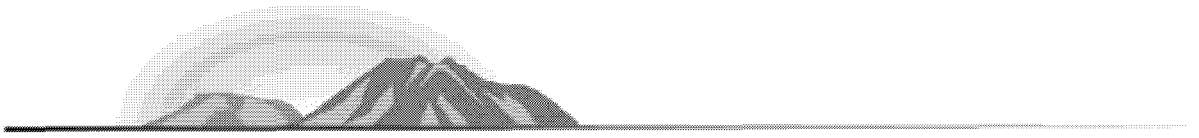
The Glovebox Excavator Method Project will cut more than 5 years from the original Stage II schedule and 37% from the original Stage II cost of performing a retrieval demonstration at a specific and preselected INEEL transuranic waste site, located in Pit 9 at the Subsurface Disposal Area. The project will ensure worker and environmental safety. The Glovebox Excavator Method Project achieves DOE's 1993 Interim Record of Decision (ROD) objectives, as modified, and provides characterization data for safe interim storage.

The Glovebox Excavator Method Project's retrieval system consists of a fabric weather enclosure structure, steel confinement structure, excavator, ventilation system, and other supporting equipment. Overburden is removed to a specified depth, then the excavator arm, contained within a confinement structure, excavates an angular swath of waste zone materials. The retrieved material in the excavator bucket is placed in a transfer cart. One transfer cart is located at the entrance of each of three material-packaging gloveboxes.

The carts transport waste zone materials inside the gloveboxes, where the material is inspected, categorized, and sampled. Each of the three gloveboxes is equipped with three drum bagout stations for packaging the material into 55-gal and 85-gal drums.

After waste excavation is complete, a sampling device attached to the excavator arm takes core samples of the underburden. Overburden is then placed back into the excavation, filling approximately half the excavated volume. Then a low strength grout mixture is pumped onto the overburden fill. Deactivation, decontamination, and dismantlement activities will follow completion of excavation backfill activities.

The Glovebox Excavator Method Project's *Technical and Functional Requirements Document* published by the INEEL in 2001 sets the technical baseline for the project. Baseline requirements help control risks of delays, cost overruns, and safety infractions. Bounding assumptions underlying the project's conceptual design are listed in Appendix A.



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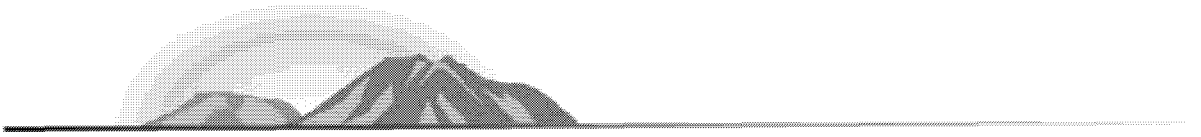


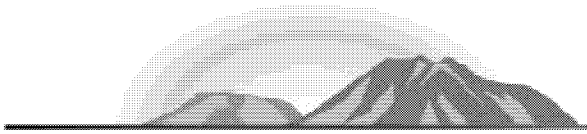
ACRONYMS

AES	Architectural Engineering Standards
AISC	American Institute of Steel Construction
ALARA	as low as reasonably achievable
AMWTF	Advanced Mixed Waste Treatment Facility
AOC	area of contamination
ARAR	applicable or relevant and appropriate requirement
ASTM	American Society for Testing and Materials
BACT	Best Available Control Technology
BNFL	British Nuclear Fuels Limited
CAM	continuous air monitor
CAS	criticality alarm system
CCTV	closed-circuit television
CD	Critical Decision
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFA	Central Facilities Area
CLP	Contract Laboratory Program
COC	contaminant of concern
CSE	Criticality Safety Evaluation
DD&D	deactivation, decontamination, and dismantlement
DOE	Department of Energy
DOE-HQ	Department of Energy Headquarters
DOE-ID	Department of Energy Idaho Operations Office
DOP	dioctyl phthalate
DOT	Department of Transportation

DQOs	data quality objectives
EDF	Engineering Design File
EPA	Environmental Protection Agency
ER	Environmental Restoration
ESD	Explanation of Significant Differences
ESH&Q	Environment, Safety, Health, and Quality
FDSA	Final Documented Safety Analysis
FFA/CO	Federal Facility Agreement and Consent Order
FFS	Facility Floor Structure
FHA	Fire Hazards Analysis
FMM	Fissile Material Monitor
FSP	Field Sampling Plan
GFE	government furnished equipment
HASP	Health and Safety Plan
HEPA	High-Efficiency Particulate Air (filter)
HVAC	heating, ventilation, and air conditioning
I&C	Instrument and Control
IBC	International Building Code
IDEQ	Idaho Department of Environmental Quality
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
IR	infrared
ISV	in situ vitrification
LMAES	Lockheed Martin Advanced Environmental Systems
MBA	Material Balance Area

MLLW	mixed low-level waste
MSA	Management Self Assessment
NDA	nondestructive assay
NDE	nondestructive examination
NEC	National Electric Code
NFPA	National Fire Protection Association
NMC	Nuclear Material Custodian
ORD	Operations Requirements Document
ORR	Operational Readiness Review
OU	Operable Unit
PC	Performance Category
PCB	polychlorinated biphenyl
PCM	personnel contamination monitor
PDSA	Preliminary Documented Safety Analysis
PGS	Packaging Glovebox System
PLC	programmable logic controller
PPE	personal protective equipment
PVC	polyvinyl chloride
QA/QC	Quality Assurance/Quality Control
QAPjP	Quality Assurance Project Plan
RA	Remedial Action
RAM	radiation air monitor
RCRA	Resource Conservation and Recovery Act
RCS	Retrieval Confinement Structure
RD/RA	Remedial Design/Remedial Action

RFP	Rocky Flats Plant
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RWMC	Radioactive Waste Management Complex
SDA	Subsurface Disposal Area
SME	subject matter expert
SMO	Sample Management Office
SOW	scope of work
SSC	system, structure, and component
SVOC	semivolatile organic compound
T&FR	Technical and Functional Requirements
TRU	transuranic
TSCA	Toxic Substance Control Act
TSR	Technical Safety Requirement
USQ	Unreviewed Safety Question
UV	ultraviolet
VOC	volatile organic compound
WAC	waste acceptance criteria
WAG	Waste Area Group
WBS	Work Breakdown Structure
WES	Weather Enclosure Structure
WIPP	Waste Isolation Pilot Plant



1. INTRODUCTION

This report presents the conceptual design for the Glovebox Excavator Method Project. The U.S. Department of Energy (DOE) chose this project to demonstrate retrieval, characterization, and interim storage of transuranic (TRU) waste from Operable Unit (OU) 7-10 at the Idaho National Engineering and Environmental Laboratory (INEEL). DOE selected the project as the best of five alternatives to resolve the formal dispute associated with the OU 7-10 Staged Interim Action, Stage II. The objective of the project is to demonstrate the safe retrieval of TRU waste from a specific and preselected area (OU 7-10) of Pit 9 in the Subsurface Disposal Area (SDA) at the Radioactive Waste Management Complex (RWMC), part of the INEEL's Waste Area Group (WAG) 7.

1.1 Background

The waste in the project area of Pit 9 primarily stems from the production of nuclear weapons during the Cold War era at DOE's Rocky Flats Plant in Colorado. The project area waste mainly consists of TRU mixed waste, comprising 74-series sludge (salt precipitates and organics, some solidified with cement), combustible (personal protective equipment, paper, rags, wood and wood filter frames, plastics, etc.) and noncombustible (angle iron, electronic instrumentation, pumps, motors, power tools, hand tools, etc.) debris waste, and drums containing graphite wastes from plutonium production. The mixed waste also includes a number of empty 55-gal drums placed in the pit and compacted with earth-moving equipment.

The waste material was placed in Pit 9 on top of a layer of clean underburden and overlaid with clean overburden. Waste material was placed in the pit between November 1967 and June 1969.

The Glovebox Excavator Method Project is greatly simplified from the Stage II 90% design submitted in June 2000. The project is primarily focused on waste retrieval. Exposure of the underburden soils so that core samples of the underburden can be obtained is also important. The project uses commercially available equipment to the maximum extent possible and ensures protection of workers, the public, and the environment. It allows efficient retrieval, packaging, and characterization for interim storage of waste zone materials. The project design meets the requirements of the Glovebox Excavator Method Project's *Technical and Functional Requirements Document.*

1.2 Scope

This report provides a snapshot of the design evolution at this stage of development, establishing and documenting the technical baseline of the project, and presenting cost and schedule information. The conceptual design is a crucial element in the Critical Decision-1 (CD-1) process. This report:

- Includes assumptions used as bases for the *Waste Area Group 7 Analysis of OU 7-10 Stage II Modifications* document published by the INEEL on October 1, 2001
- Provides conceptual-level design details addressing the technical and functional requirements
- Establishes conceptual budgetary cost estimate information for the project
- Provides a basis for the preliminary documented safety analysis
- Provides a basis for preliminary operational planning

- Documents and evaluates the impact of relevant environmental, safety, and health requirements
- Documents other required project assessments so that their impact can be included in future project planning.

The report consists of seven sections—Introduction, Project Basis, Technical Description, Conceptual Cost Estimate, Project Schedule, Project Assessments, and References—and appendixes.

2. PROJECT BASIS

The *Waste Area Group 7 Analysis of OU 7-10 Stage II Modifications* identifies a path forward for an OU 7-10 waste retrieval demonstration that achieves the objective of demonstrating a feasible approach for retrieving waste zone material from OU 7-10. The Glovebox Excavator Method Project was established to accomplish the following objectives presented in that report:

- Demonstrate waste zone material retrieval
- Provide information on any contaminants of concern present in the underburden
- Characterize waste zone material for safe and compliant storage
- Package waste zone material in containers acceptable at the Advanced Mixed Waste Treatment Facility (AMWTF).

2.1 Analysis of Potential Waste Retrieval Methods

The Glovebox Excavator Method was determined to be the best strategy for completing the demonstration retrieval for Pit 9 based on the evaluation and ranking of five potential modifications to the OU 7-10 Stage II 90% design, described in detail in the *Waste Area Group 7 Analysis of OU 7-10 Stage II Modifications*.

A multidisciplinary team of INEEL contractor personnel consisting of design, construction, and operations professionals was tasked with determining a path forward for demonstrating a feasible approach to retrieving waste from Pit 9. The multistep process developed and used by the team to accomplish this task is illustrated in Figure 2-1.

The Glovebox Excavator Method is the most feasible approach. Its selection is firmly based on the evaluation and ranking of five potential modifications:

- Glovebox Excavator Method
- Simplified Stage II 90% Design
- Cased Excavation Method
- Progressive Retrieval Method
- Alternate Waste Location Method.

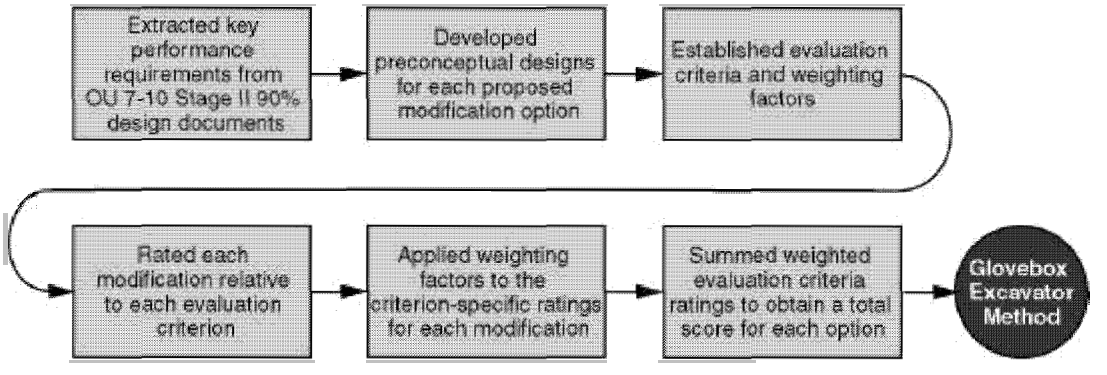


Figure 2-1. The INEEL team used comparative analysis to identify a feasible approach for retrieving waste zone material from Pit 9.

Using this process, the team identified five potential methods and developed each into a fully integrated waste retrieval modification of the original OU-7-10 Stage II 90% design. Those five modifications and their key design features, compared to the Stage II 90% design, are listed in Table 2-1.

Each of the five new retrieval methods was analyzed using various weighted evaluation criteria, then scored and ranked. Based on the final ranking, the Glovebox Excavator Method emerged as the most favorable choice for the waste retrieval demonstration project because it provides the best balance of schedule, cost, and risk of the five methods.

Table 2-1. Potential methods for retrieving waste zone material and their key features.

Key Design Features
Original Stage II 90% Design: – Large excavation confinement structure with remote excavator and telescoping manipulator; two material handling gloveboxes – Specially designed and fabricated nonstandard excavator arm on rail system – Fabric weather enclosure over confinement structure and material packaging gloveboxes – Highly controlled retrieval excavations.
Glovebox Excavator Method: – Prefabricated modular steel panel confinement structure; fabric weather enclosure – Commercial excavator with only excavator arm inside confinement structure – Three material packaging gloveboxes.
Simplified Stage II 90% Design: – Simplified 90% design with same excavation glovebox and two simplified material-handling gloveboxes – Two fixed excavator arms and standard bridge crane.
Cased Excavation Method: – Fifty 24-in. steel-cased retrieval locations – Material removed with multiple recovery tools within a portable glovebox – Wastes retrieved and packaged in glovebox structure.
Progressive Retrieval Method: – Use of multistep retrieval process with multiple starts and pauses – Overburden excavated with backhoe (Phase 1) – Backhoe used to retrieve empty drums within weather enclosure (Phase 2) – Glovebox Excavator Method used to retrieve lower (Phase 3) and higher-risk (Phase 4) wastes.
Alternate Waste Location Method: – Uses Glovebox Excavator Method, but retrieval area sited to recover lower-risk waste materials – Focused on sludge retrieval.

2.2 Assumptions

Appendix A summarizes the constraints and assumptions used in developing the project scope of effort, work plan, cost estimate, and schedule. These constraints and assumptions are organized into the following sections: scope, cost, and schedule. The project work plan, cost estimate, and schedule are not valid if these constraints and assumptions are not fulfilled.

2.3 Technical and Functional Requirements

The Glovebox Excavator Method Project's Technical and Functional Requirements (T&FR) document establishes the technical baseline for the project. The requirements in the T&FR are intended to meet the joint objectives of the DOE Idaho Operations Office (DOE-ID), U.S. Environmental Protection Agency (EPA), and Idaho Department of Environmental Quality (IDEQ)—collectively known as the Triparty Agencies, and hereafter referred to as "Agency."

The T&FR defines the requirements for the project to the extent that the requirements are known at the beginning of conceptual design. It is not intended to define analysis or evaluation tasks that may be necessary as part of the design activity. The T&FR captures overall project requirements for retrieving, packaging, and temporarily storing the waste zone material excavated from the project site located in a preselected area of Pit 9 (see Section 3 for a detailed description of the excavation site).

The project design, procurement, construction, reviews, testing, and acceptance for delivery are based on the requirements in the T&FR. Figure 2-2 compares the general objectives from the Agency documents (Record of Decision [ROD], Explanation of Significant Differences [ESD], Scope of Work [SOW], etc.) with the current objectives for the project.

Figure 2-2. Comparison of general objectives.

Agency Documents Stage II	Glovebox Excavator Method Project
Obtain information to support the WAG 7 decision process, including characterization and treatability information.	The retrieval demonstration in Pit 9 will provide information on contaminants of concern present in the Pit 9 underburden.
Obtain characterization information.	Characterization of waste zone material will support safe and compliant storage. Data will be used for AMWTF acceptance criteria. Underburden will be sampled for TRU contaminants and chemical analysis.
Include treatability study testing.	Treatability study testing has been deferred.
Develop information to support the design and operation of a Stage III system that will meet the requirements established in the Pit 9 ROD.	Retrieval is to demonstrate the ability to retrieve waste zone materials. Data from the project will be used for establishing the path forward.
Stage II activities include design, construction, startup activities, excavation, and retrieval of waste and soils from Pit 9.	The retrieval demonstration will make use of one Pit 9 location, and will not be designed to be relocated.
Remove approximately 200 yd^3 of containerized waste and interstitial soil from the 20 × 20-ft area.	The excavation volume will be between 75 to 125 yd^3 of waste zone materials. Underburden will not be excavated. Samples of underburden will be collected.
Materials that are not returned to the pit as part of Stage II will be containerized.	Retrieved waste zone materials will be containerized.
Retrieved materials not returned to the pit are staged for further sampling within the area of contamination (AOC) pending final disposition.	Retrieved waste zone materials will be characterized for safe interim storage and for acceptance by AMWTF.
Includes both primary and secondary confinement.	A weather enclosure surrounds a confinement structure.

2.4 Data Quality Objectives

The Data Quality Objectives (DQOs) developed for the Glovebox Excavator Method Project (see Appendix B) support the project design process; drive design criteria for the facilities and equipment used in or supporting excavation, retrieval, packaging, and disposition of Pit 9 waste zone material; and provide a basis for the associated Field Sampling Plan (FSP).

By developing DQOs, the project is able to make cost-effective data-collection decisions to meet specific needs and comply with EPA's "Guidance for the Data Quality Objectives Process" and EPA Order 5360.1 A2, which requires all EPA organizations (and organizations with extramural agreements with EPA) to follow a systematic planning process to develop acceptance or performance criteria for the collection, evaluation, or use of environmental data. The DQOs were developed by a multidisciplinary team of subject matter experts from Design Engineering, Environmental Compliance, Quality Assurance, Project Management, Sampling and Analysis Planning, Sample Management, and Systems Engineering. The team received authority to determine the DQO scope and development process.

With buy-in from DOE-ID, IDEQ, and EPA, a tailored EPA DQO process (see Figure 2-3) was selected that uses the requirements found in the project's T&FR document.

Outputs of the process result in DQOs, which are statements that clarify the objective of the data collection effort, specify how the data will be used to support the decisions being addressed, define the most appropriate type of data to collect, specify acceptable decision errors that will be used for establishing the quantity and quality of data needed (a decision error rate is the probability of making an incorrect decision based on data that inaccurately estimate the true conditions at the site), and specify the quantity and quality of the data to be collected.

The DQOs listed in Appendix B include (a) general project data objectives that cover cost, collection, public and worker safety, and design evaluation; (b) waste and soil characterization objectives that cover segregation, safe retrieval, safe storage, and dispositioning; and (c) characterization objectives for determining contaminants in the underburden.

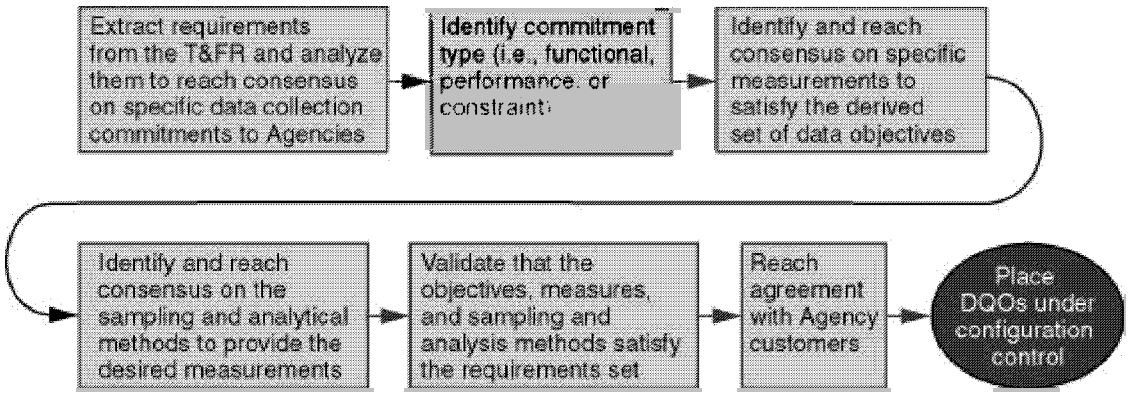


Figure 2-3. The multidisciplinary team used a tailored EPA process to develop the DQOs.